Break Separator Level Measurement Effects

by

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Tuesday, June 25, 1996

The Break Separator's liquid level measurement, until recently, has proved to be incorrect during the initial period of a test. The initial liquid level appears to decrease for a two-inch break diameter. Figure 1 shows the general locations of the Differential Pressure (DP) Transducer's pressure taps on the Break Separator. Originally, the lower tap was located on the vertical section of the Loop Seal as shown by the dashed line. Recently, the lower tap was moved to the location on the bottom of the Break Separator as shown.

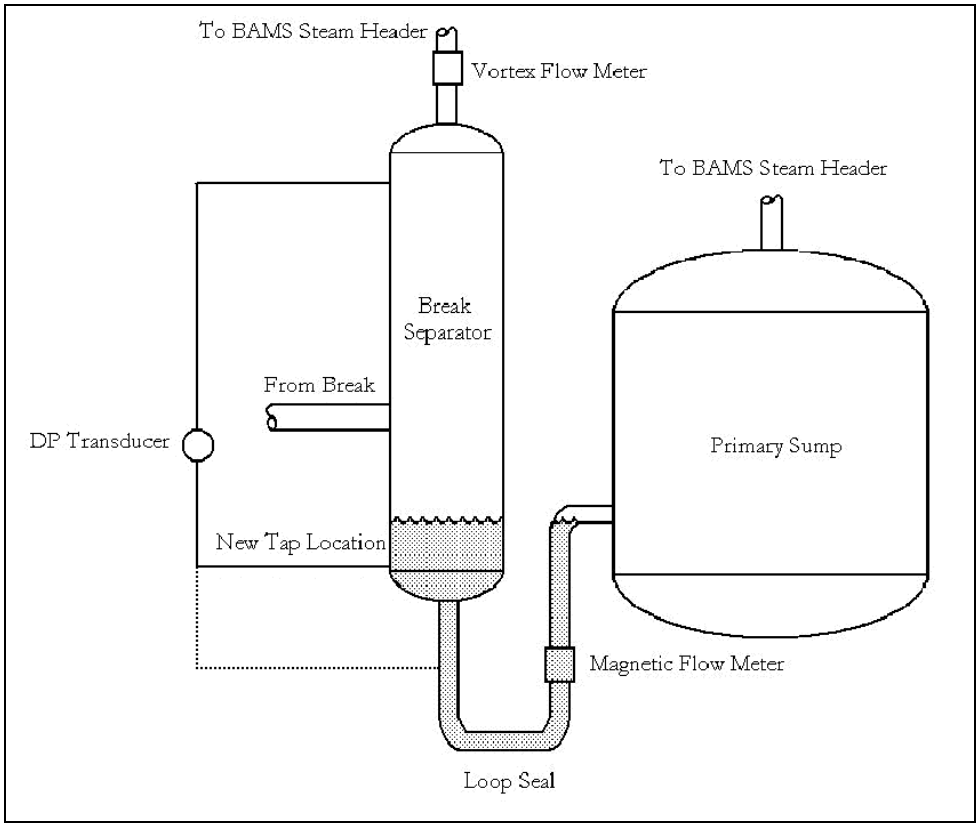

Figure 1. Break Separator liquid level instrumentation diagram.

This relocation of the pressure tap has eliminated any pressure loss effects upon the liquid level measurements taken by the DP Transducer. This change in the resulting data is demonstrated below, and Table 1 lists some specifics of each test reviewed.

Table 1. Description of break geometry and DP Transducer lower pressure tap location with respect to test identification.

Test ID	*Break Size/Description*	*Lower DP Transducer Tap Location*
SB-11	Double- ended DVI break	Vertical section of Loop Seal
NRC-5111	Two-inch diameter break Bottom of Cold Leg #3	Vertical section of Loop Seal
NRC-6018	Two-inch diameter break Bottom of Cold Leg #3	Bottom of Break Separator tank
NRC-6020	Double- ended DVI break	Bottom of Break Separator tank

Figure 2 compares the separator levels for the two-inch break tests, NRC-5111 and NRC-6018, and the NRC-5111 data has been adjusted to match that of NRC-6018 by subtracting 107.24 cm which is the elevation difference between the old and new lower tap locations. The NRC-5111 data shows an apparent level depression within the separator, but NRC-6018 shows that the relocation of the lower DP Transducer pressure tap to the bottom of the Break Separator eliminated the level measurement error seen in NRC-5111. As a result, Figure 3 shows the corresponding break flow rates of NRC-5111 and NRC-6018. For NRC-5111, the break flow rate shown does not include the accumulation of liquid within the separator so the apparent level depression may be ignored. Due to the lack of the accumulation, the NRC-5111 flow rate does not reach a steady-state value immediately. NRC-6018 flow rate data shows the inclusion of the Break Separator liquid accumulation yields a nearly immediate flow rate measurement response from the BAMS.

For the double-ended DVI (Direct Vessel Injection) breaks, Figure 4 and Figure 5 show respectively that the Break Separator liquid level measurement and the measured break flow rates are similarly affected by the relocation of the DP Transducer lower pressure tap – though not as significantly as the two-inch break simulations – given the same data analysis procedure as used on NRC-5111 and NRC-6018 data.

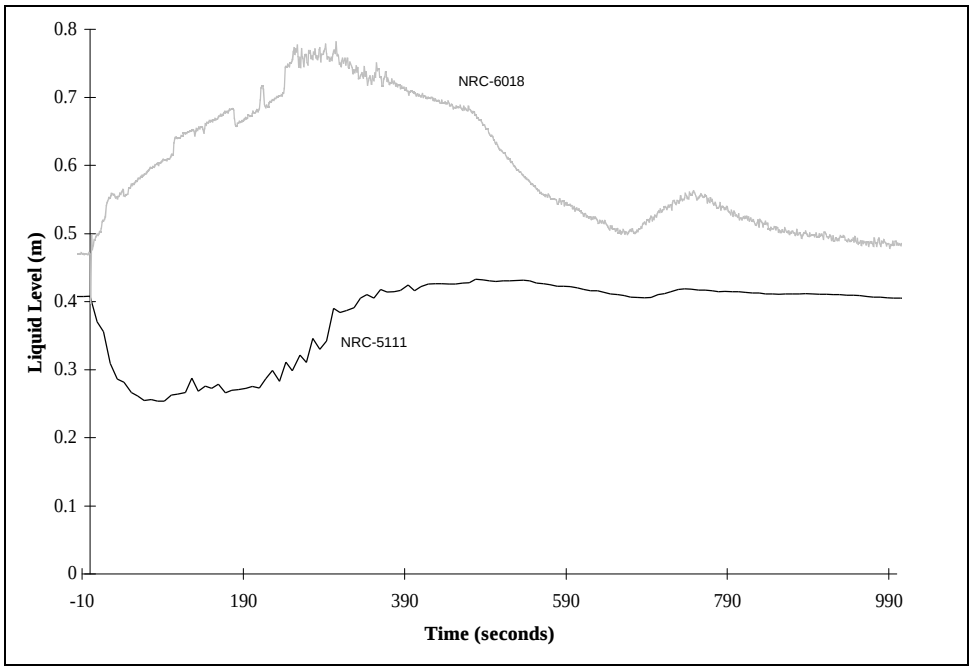

Figure 2. Break Separator time-dependent liquid level comparison for the simulated two-inch diameter break.

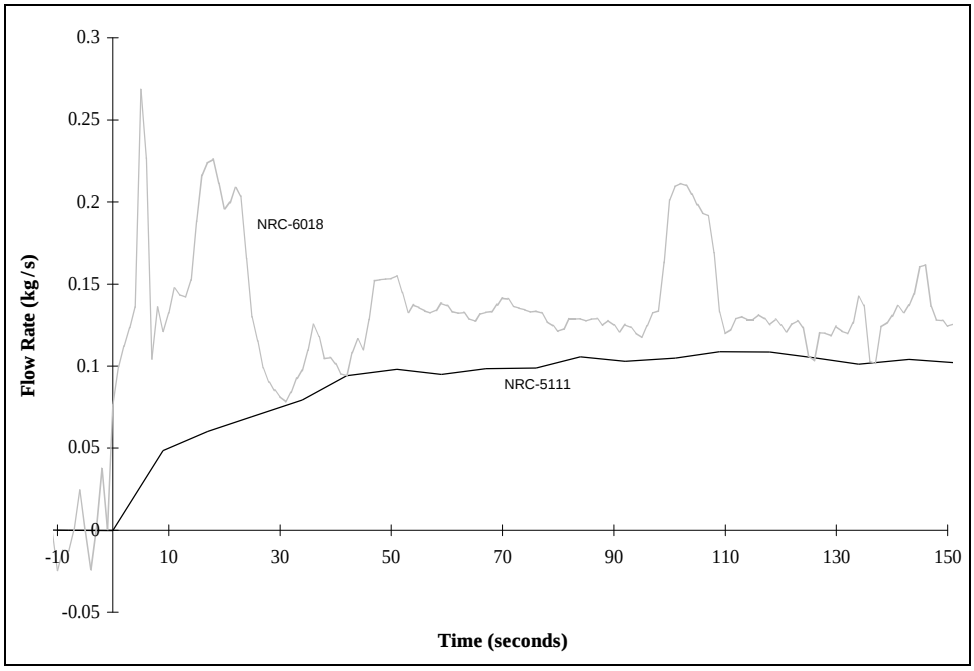

Figure 3. Break flow rate comparison for the simulated two-inch diameter break.

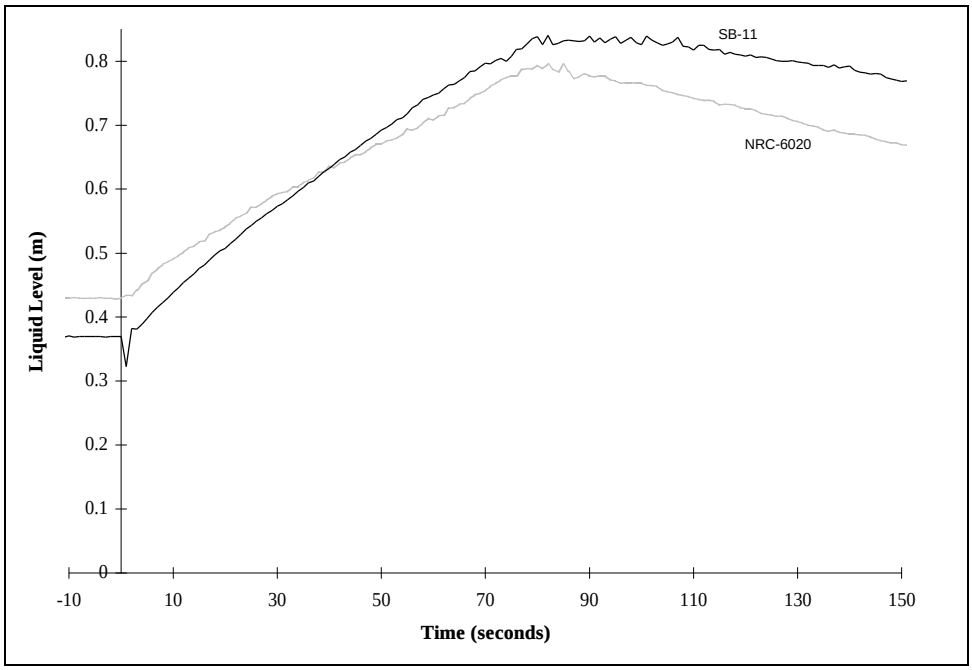

Figure 4. Break Separator time-dependent liquid level comparison for the double-ended DVI break.

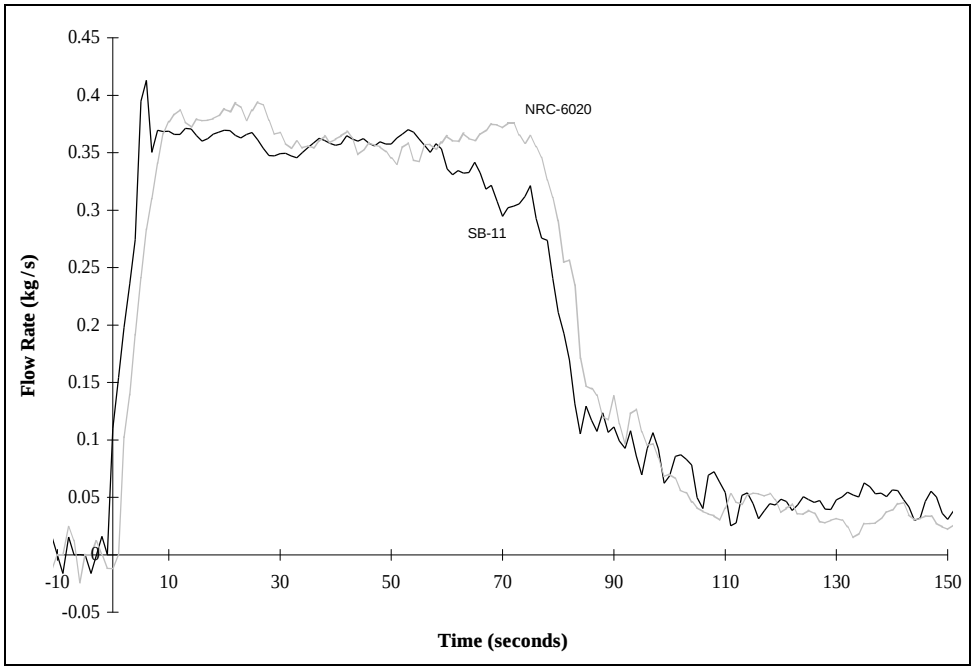

Figure 5. Break flow rate comparison for the double-ended DVI break.